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PCT/GB2005/001164

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1. Your reference — 33/42/64697GB

2. Patent application number *(The Patent Office will fill in this part)* — 0406945.6 — 27 MAR 2004

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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Partners: William Francis
Daniel Muir
Marie
and Anna McCulloch

Cf. 27/4/05.

Patents ADP number *(if you know it)* — 88387240001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention — Rail Track Handling Apparatus and Method

5. Name of your agent *(if you have one)* — Fitzpatricks

"Address for Service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

4 West Regent Street
Glasgow
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G2 1RS

DECLARATION FILED 29.3.05.

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6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

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8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?
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a) any applicant named in part 3 is not an inventor or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO See note (d)) — Yes

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	13
Claim(s)	
Abstract	
Drawings(s)	4 + 4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) FITZPATRICKS Wendy Henderson Date 25 March 2004

12. Name, daytime telephone number and email address, if any, of person to contact in the United Kingdom — Ken Peter — 0141 306 9000

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RAILWAY LINE HANDLING APPARATUS AND METHOD

The present invention relates to railway line handling apparatus, a method of handling a section of railway line using such apparatus, and a railway line handling device.

Railway maintenance may involve replacing sections of railway track when the railway track has become unusable through wear. As the inside edges of railway lines tend to wear faster than the outside edges, a further maintenance activity is the exchanging of one section of a pair of lines in a length of track for the other in the pair. Exchanging sections of line in this fashion presents the former unworn outside edge as an inside edge and may double the working life of each section of line.

It is known within the railway maintenance industry to use what is termed road-rail plant to carry out a number of maintenance tasks, including the movement of sections of railway line. Road-rail plant is termed as such because it is provided with both ground engaging wheels and rail track engaging wheels so that it is capable of moving over the ground and along a railway track. Typically, road-rail plant has an extendible boom to which is attached a rail grab device; the boom is usually rotatable about the road-rail plant carriage.

In a typical railway track replacement task, sections of replacement line are deposited by the side of the railway. The road-rail plant is moved into position at the part of the track under maintenance and the boom extended so that the rail grab device can engage with a section of existing line which has been loosened from the track. Then the boom is manipulated to move the section of existing line from the track to the ground to one side of the track. The rail grab device of the road-rail plant is then used to engage with a section of replacement line and the boom manipulated to move the replacement section over the ground to deposit it onto the track. When the rail moving operation is complete, the replacement section of line is secured to the track.

The present applicant has realised that the known approach of using a road-rail plant to handle sections of railway line has shortcomings. This realisation has

motivated the applicant to devise an innovative approach to railway line handling which addresses these shortcomings.

Thus, in accordance with a first aspect of the invention there is provided railway line handling apparatus comprising line displacing means configured to engage a section of railway line along part of its length, the line displacing means being further configured for its progressive movement longitudinally along the section of railway line and, as it so moves, for progressive bending of the section of railway line laterally of an unbent part of the section of railway line to thereby displace the section of railway line from a first position to a second position, the railway handling apparatus defining a footprint over the ground, and the line displacing means being, in use, operative within the footprint.

A maintenance operation may involve displacing a section of railway line, which is to be replaced, from a first position to a second position, e.g. from a railway track to one side of the railway track. Accordingly, the displacing means may be configured to progressively bend the section of railway line laterally over the ground.

In such a maintenance operation, the railway line handling apparatus may be positioned such that the line displacing means is located generally over the side of the railway track to which it is desired to move the section of railway line. Then an end of the section of railway line may be bent towards and brought into engagement with the line displacing means. The bending of the end of the section of railway line is made possible by its inherent flexibility. When the end of the section of railway line has been brought into engagement with the line displacing means, the line displacing means may be moved progressively and longitudinally along the section of railway line. As the line displacing means moves progressively along the section of railway line, it progressively bends successive parts of the section laterally of an unbent part of the section and in a direction away from the railway track to displace them to one side of the railway track. The progressive bending of the section relies to a large extent on the inherent flexibility of the railway line.

When the apparatus is used to displace a replacement section of railway line from one side of the track onto the track, the above described operation may be

repeated starting with the line displacing means located generally over the position on the railway track to where it is desired to displace the replacement section of railway line.

The displacing means may be further configured to support the section of railway line above the ground. Thus, operation of the line displacing means within the footprint of the railway line handling apparatus can reduce the likelihood of forces exerted by the weight of the section of railway line, as it is supported above the ground, causing an imbalance in the apparatus. Thus, the need for counter-balances seen in known handling apparatus can be reduced. The presence of counter-balance weights in known handling apparatus can increase the weight of the apparatus such that it is liable to damage or disrupt the railway track. For example, known handling apparatus may disturb the ballast supporting the railway sleepers, necessitating time consuming work to remedy the disturbance.

The apparatus may be configured for movement of the line displacing means in a direction lateral of the section of railway line as the line displacing means moves along the section of railway line. Thus, lateral movement of the line displacing means can allow for control of where the section of railway rail is displaced. For example, at the start of a railway line moving operation the line displacing means may be positioned closer to an end of a section of railway line to be moved so that the end need not be bent to a large extent before it is brought into engagement with the line displacing means. Lateral movement of the line displacing means can then be used to compensate for positioning the line displacing means closer to the end of the section of railway line by allowing for the section to be displaced to a desired position.

More specifically, the railway rail handling apparatus may be configured for movement over the ground and steering in a direction lateral of the section of railway line, the line displacing means being configured to move with the apparatus.

The apparatus may further comprise two spaced apart apparatus support members for supporting the apparatus over a railway track, the line displacing means being located between the two apparatus support members. Thus, forces developed during bending of a section of railway line can be distributed between

the two apparatus support members. Where the line displacing means supports a section of railway line above the ground, the weight of the section borne by the line displacing means can be distributed between the two apparatus support members. The railway line handling apparatus may be configured to distribute the weight substantially equally between the two apparatus support members. For example, the line displacing means may be located substantially half-way between the two apparatus support members. Thus, in certain forms of the invention the need for counter balancing weights seen in known rail handling apparatus can be dispensed with.

More specifically, the apparatus may be configured such that the line displacing means depends between the apparatus support members. Thus, the apparatus may comprise a chassis means supported on the apparatus support members with the line displacing means depending from the chassis means. The apparatus support members may be of a length which, in use, elevates the chassis means above a railway track by a distance sufficient allow the line displacing means raise a section of railway line above the ground for proper operation of the line displacing means. Typically, the apparatus support members raise the chassis means about 1m above the railway track. Such forms of the invention may provide for track handling apparatus of moderate height in contrast to known railway line handling apparatus. The moderate height of such forms of the present invention may provide for easier operation in the vicinity of overhead structures, such as overhead power lines, the roofs of tunnels and bridges.

The chassis means may provide a platform upon which to mount further components of the railway line handling apparatus, such as apparatus control equipment, pneumatic devices and power generating equipment.

The line displacing means may be configured to be extendible. Thus, an elevation over the ground of a section of railway line supported by the line displacing means may be varied. More specifically, the line displacing means may be progressively extendible. Extendibility may be achieved by providing the line displacing means with a telescopic body.

The line displacing means may be configured for movement in relation to the railway line handling apparatus in a direction lateral of a section of railway line engaged or to be engaged by the line displacing means.

More specifically, the line displacing means may be configured to swivel in relation to the railway line handling apparatus. The line displacing means may have an elongate body, with a first end of the elongate body mounted to swivel on the apparatus and a second opposite end of the elongate body configured to engage a section of railway line. Thus, swivelling of the line displacing means can bring it closer to an end of a section of railway line at the start of a railway line moving operation. This can have the advantage of reducing the extent to which the section of railway line needs to be bent before it engages with the line displacing means. Configuring the line displacing means for extendibility can also help bring the line displacing means closer to the end of the section of railway line at the start of a railway line moving operation.

Alternatively or in addition, the line displacing means may comprise user operable arresting means for arresting movement of the line displacing means in relation to the apparatus in a direction lateral of a section of railway line. Thus, when an end of a section of railway line has been brought into engagement with the line displacing means the arresting means may be operated to prevent further lateral movement of the line displacing means in relation to the apparatus. For example, the arresting means may be a pin or the like that a user inserts into the line displacing means to prevent it from swivelling in relation to the apparatus.

The line displacing means may be configured for rotational movement in relation to the railway line handling apparatus about an axis extending from the ground, when the railway line handling apparatus is in use, and substantially perpendicular to a longitude of a section of railway line engaged by the line displacing means. In use, the line displacing means can rotate to a position in relation to the railway line handling apparatus to suit an angle to which the section of railway line is to be or is being bent.

The line displacing means may define an aperture for receiving a section of railway line lengthwise. More specifically, the aperture may be of sufficient

dimensions to accommodate discontinuities and projections encountered on a surface of a section of railway line, such as bolts, weld seams and fissures.

More specifically and according to a first form of the invention, the line displacing means may be configured to completely encircle the part of the length of section of railway line engaged by the line displacing means. This can have the advantage, in comparison with known rail grab devices and the like, of providing for secure engagement of the section of railway line. For example, a line displacing means according to the first form of the invention is less likely to drop a section of railway line on encountering discontinuities and projections on the surface of the section.

More specifically, the line displacing means may have a gate means moveable to allow a section of railway line to be received by the line displacing means. Thus, the gate means may be moved at the start of a railway line moving operation to permit reception and engagement of a section of railway line by the line displacing means. For example, the gate means may be mounted for rotation on a rotatable mounting. The gate means may have locking means for locking the gate means in a closed position.

The line displacing means may be configured for ease of its movement longitudinally along a section of railway line engaged by the line displacing means. The line displacing means may be configured for ease of movement by means of one or more devices that engage with the section of railway line, such as rollers, bearings, low friction surfaces, etc.

The apparatus may be configured to provide a rigid connection to the line displacing means at least in a direction lateral of a section of railway line engaged in the line displacing means. Thus, a force for bending a section of railway line may be properly and controllably transmitted from the apparatus to the line displacing means.

The railway line handling apparatus may further comprise railway line raising means. The railway line raising means may be used to help raise an end of a section of railway track towards the line displacing means, for example at the start of a railway line moving operation. The raising means may, for example, comprise a block and tackle arrangement.

The railway line handling apparatus may further comprise moving means for moving the railway line handling apparatus.

More specifically, the railway line handling apparatus may comprise two spaced apart apparatus support members for supporting the apparatus over a railway track with the moving means provided on the apparatus support means.

Alternatively or in addition, the moving means may be operable to steer the railway line handling apparatus in a direction other than longitudinally along the section of railway line. Thus, the moving means may be used not only to move the line displacing means longitudinally along a section of railway line but also to impart a force in a direction lateral of the section of railway line to progressively bend the section.

Alternatively or in addition, the moving means may comprise one or both of wheel means, such as a plurality of ground engaging wheels, or railway track engaging means for moving the railway line handling apparatus along a railway track.

The railway track handling apparatus may comprise pneumatic systems for actuating one or more moving parts of the apparatus.

The railway track handling apparatus may comprise a generator for providing power to actuate one or more moving parts of the apparatus.

The railway track handling apparatus may comprise user control means for user control of the apparatus.

One or more of the component parts of the railway track handling apparatus may be formed of metal, such as steel.

According to a second aspect of the present invention, there is provided a method of handling a section of railway line by means of a railway line handling apparatus, the method comprising engaging a section of railway line along part of its length by a line displacing means of the railway line handling apparatus, and progressively moving the line displacing means longitudinally along the section of railway line whilst using the line displacing means to progressively bend the section of railway line laterally of an unbent part of the section of railway line to thereby displace the section of railway line from a first position to a second

position, in which the line displacing means is operated within a footprint of the railway line handling apparatus.

Forms of the second aspect of the invention may comprise one or more of the features described above in relation to the first aspect of the invention.

The present applicant has realised that a line displacing means according to the first form of the invention defined above may have wider application than hitherto described. Thus, according to a third aspect of the present invention there is provided a railway line handling device, which is configured to receive a section of railway line lengthwise and to engage the section along part of its length and for progressive, longitudinal movement along the received section of railway line and, as it so moves, for progressive bending of the section of railway line laterally of an unbent part of the section of railway line, the device being further configured to completely encircle the part of the length of section of railway line engaged by it.

A railway line handling device according to the third aspect of the invention can have the advantage, in comparison with known handling devices, such as the rail grab device, of providing for secure support of a section of railway line. For example, a railway line handling device according to the third aspect of the invention is less likely to drop a section of railway line on encountering discontinuities and projections on the surface of the section, such as bolts, weld seams and fissures.

Forms of the third aspect of the invention may comprise one or more of the features described above in relation to the first and second aspects of the invention.

According to a fourth aspect of the present invention, there is provided a railway line handling apparatus, as defined below, having a railway line handling device according to the third aspect of the present invention.

For the purpose of the fourth aspect of the present invention, railway line handling apparatus is defined as comprising a railway line handling apparatus according to the first aspect of the present invention, known road-rail plant as described hereinabove and other such prior art forms of railway line handling apparatus.

A specific embodiment of the present invention will now be described by way of example only and with reference to the following drawings, in which:

Figure 1a is a side view of a railway line handling apparatus according to the invention;

Figure 1b is a front view of the railway line handling apparatus of Figure 1a;

Figure 2 is a detailed front view of the displacing means of Figures 1a and 1b when open to receive a section of railway line;

Figure 3a is a side view of the railway line handling apparatus of Figure 1a when engaged with a section of railway line;

Figure 3b is a front view of the railway line handling apparatus of Figure 1b when engaged with an end of a section of railway line; and

Figure 4 is a plan view of the apparatus of Figures 1a to 3b in operation.

Referring to the drawings, Figures 1a and 1b respectively provide side and front views of a railway line handling apparatus 10 according to the invention. The apparatus 10 comprises line displacing means 12, which is located approximately half way between and depends between two spaced apart apparatus support members 14, 16. The line displacing means 12 depends from a chassis 18, which is supported on the two spaced apart apparatus support members 14, 16. On the chassis 18 are supported a pneumatic system 20, a generator 22 and a user control 24, which provide pneumatic actuation, generation and user control of the railway line handling apparatus in accordance with known techniques. In addition, a block and tackle arrangement 26 is mounted on the front of the chassis 18. The block and tackle arrangement can be moved to one of several positions between the spaced apart support members 14, 16. A continuous chain tread 28 (which constitutes moving means) is provided at the end of each of the two spaced apart apparatus support members 14, 16.

Figure 2 shows the line displacing means 12 of Figures 1a and 1b in more detail. With reference to Figures 1a, 1b and 2, the line displacing means comprises an elongate telescopic body 40, having a first part 42 that is telescopically received in a second part 44. Referring now again to Figures 1a and 1b, the upper end of the body 40 is mounted on the chassis 18 by means of a coupling 46, which provides for swivelling and/or rotation of the line displacing means in relation to the chassis. A pin (not shown and which constitutes arresting means) is inserted by an operator

into an upper part of the line displacing means to arrest swivelling and/or rotation in relation of the chassis.

At the end of the line displacing means 12 opposite the end having the coupling 46, the line displacing means is configured to define an aperture 48 for receiving a section of railway line. The aperture 48 is defined by two spaced apart side members 50, 52, a plate 54 substantially perpendicular to the spaced apart side members 50, 52 and a roller 56 (which constitutes a gate means) spaced apart from the plate. The aperture is of sufficient dimensions to accommodate discontinuities and projections encountered on a surface of a section of railway line, as the line displacing means is moved along the section. As can be seen from Figure 2, the side members 50, 52 can be rotated in the direction of the arrows. As the roller 56 is attached to one of the side members 50, rotation of that side member 50 swivels the roller 56 to one side, thereby permitting a section of railway line to be received between the side members from below. When the roller 56 is in the closed position shown in Figure 1a, a retractable bolt 58 provided on the roller 56 is received in a corresponding locking aperture 60 provided in one of the side members 52.

As shown in Figure 2, two rotatable handle supports 62, 64 are provided on the top of the plate 54, with a handle 66 extending from a side of one of the handle supports 62. The handle supports 62, 64 and handle 66 are not shown in Figures 1a and 1b for the sake of clarity. The handle supports can be rotated sideways, as shown in Figure 2. The handle supports 62, 64 may be rotated independently of the side members 50, 52; alternatively, the side members and handle supports may be in mechanical communication such that a handle support will rotate with its corresponding side member. When the two handle supports 62, 64 are rotated towards each other such that they extend forward of the line displacing means 12, the handle 66 that extends from one of the handle supports 62 engages with the other handle support 64 to provide a convenient operator handle, which extends across the front of the line displacing means 12.

Structural parts of the railway line handling apparatus, such as the chassis 18, the support members 14, 16, the block and tackle arrangement 26, the line displacing means 12, etc, are largely formed of a metal, such steel. The continuous chain tread 28 may be formed of rubber, plastics or similar such material.

A height of the railway line handling apparatus 10 from the ground to the chassis 18, when the apparatus is standing on the continuous chain tread 28 is about 1m. A width of the chassis 18 from one support member to the other 14, 16 is about 1m. A length of the apparatus from the front of the continuous chain tread to its rear is about 1.7m and the length of the chassis is about 1m. The line displacing means has a diameter of about 0.2m. The length of the line displacing means in the fully retracted state is about 0.7m and in the fully extended state is about 0.9m. The aperture for receiving a section of railway line defined by the line displacing means is about 0.2m high and 0.2m wide.

Turning now to Figures 3a, 3b and 4, it will be seen that these figures illustrate a use of the apparatus shown in Figures 1a, 1b and 2. Accordingly, the reader is directed to the description given with reference to Figures 1a, 1b and 2 in the preceding paragraphs for a description of those components that are common to Figures 1a to 4.

Referring to Figures 3a, 3b and 4, use of the railway line handling apparatus will now be described. The railway line handling apparatus 10 is manoeuvred over the ground by means of the continuous chain tread 28 so that the line displacing means 12, when substantially vertical to the ground, is over a location (e.g. part of a railway track) to which it is desired to move a section of railway line. The side members 50, 52 and the rotatable handle supports are rotated to take up the position shown in Figure 2. The pin, which is used to arrest swivelling of the line displacing means is removed. In addition, the block and tackle arrangement 26 is moved to a position between the two spaced apart members 14, 16, which is above or at least as close as possible to a section of railway line 80 lying on the ground. Then, the line displacing means 12 is swivelled sideways towards the section of railway line 80 and, at much the same time, the block and tackle arrangement 26 used to raise an end 82 of the section of railway line above the ground and towards the open end of the line displacing means 12. If need be, an operator may use the inherent flexibility of the section of railway line to bend the end of the section laterally towards the line displacing means, e.g. by means of a crowbar or other such tool. The line displacing means 12 and the end 82 of the section of railway line are manoeuvred so that the end 12

is received in the aperture 48 defined by the side members 50, 52 of the line displacing means 12. The telescopic body 40 of the line displacing means 12 may be extended or retracted to aid location of the end 82 of the section in the aperture 48.

When the end 82 of the section is properly received in the aperture 48, the side members 50, 52 (along with the handle supports 62, 64) are rotated to close the line displacing means 12 so that that they take up the position shown in Figures 3a and 3b. The block and tackle arrangement 26 can now be disengaged from the end of the section of railway line. In this position, the retractable bolt 58 is received in the corresponding locking aperture to hold the side members 50, 52 and roller 56 securely in place. Thus, as shown in Figure 3b, the line displacing means completely encircles the end 82 of the section of the railway line. The end 82 of the section rests on the roller 56 and thus part of the section of railway line (see Figure 3a) is supported above the ground. The set-up procedure concludes with the line displacing means 12 being swivelled back to be substantially vertical to the ground and the pin re-inserted to arrest further swivelling of the line displacing means 12 in relation to the chassis 18. This concludes the set-up procedure.

Upon conclusion of the set-up procedure, the railway line handling apparatus 10 is driven on the continuous chain tread 28 so that the line displacing means 12 moves longitudinally along the section of railway line 80. The presence of the roller 56 provides for ease of movement of the line displacing means along the section of railway line. Rotation of the line displacing means 12 in relation to the chassis 18 about an axis extending substantially vertically from the ground can ease travel of the line displacing means along the section of railway line.

Figure 4 provides a plan view of the railway line handling apparatus 10 in operation, with the arrow indicating the direction of movement of the apparatus along the section of railway line 80. As the apparatus 10 moves progressively along the section of railway line, the line displacing means 12 engages with successive parts of the section to bend them laterally of the as yet unbent part of the section in a continuous manner. The bending of the section of railway line is made possible by its inherent flexibility. Thus, the section of railway line is progressively displaced from its initial location to a location generally below the

line displacing means 12. This operation continues until the end of the section of railway line is reached. Control of a direction of movement of the apparatus can be achieved by independent control of the two continuous chain treads 28. Adjusting the direction of movement allows an operator to control to where the section of railway line is displaced. Typically, the line displacing means 12 is disengaged from the section of railway line by driving the apparatus 10 until the furthest end of the section is reached and the furthest end drops from the line displacing means. As may be best appreciated by viewing Figure 4, the line displacing means 12 is operative within a footprint defined by the railway handling apparatus 10 over the ground.

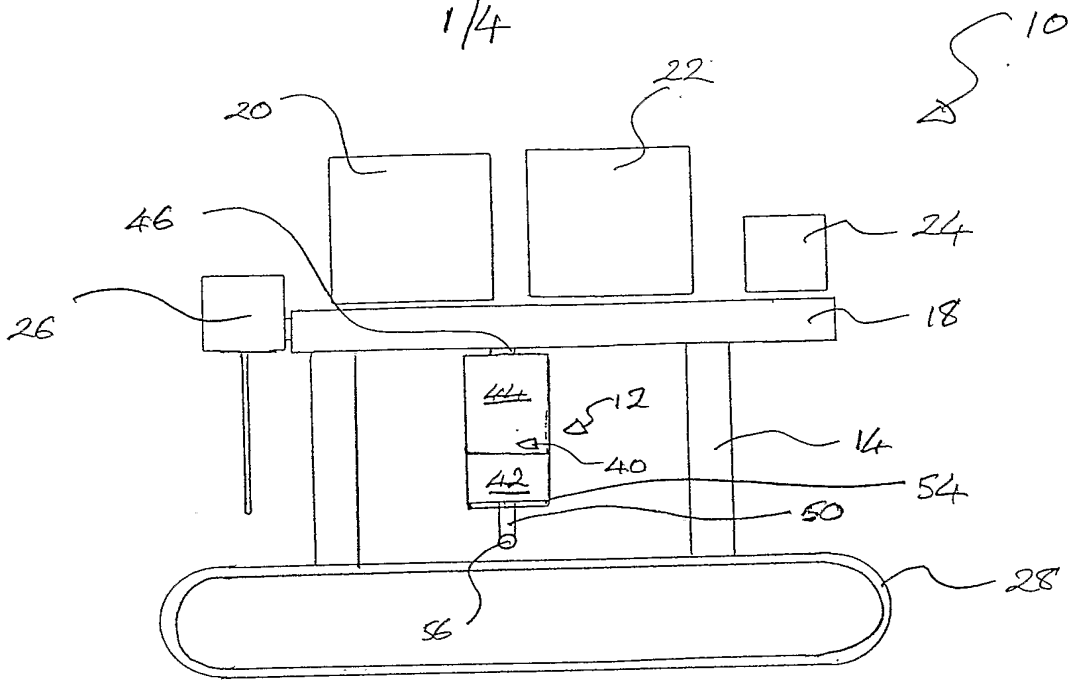

Figure 1a

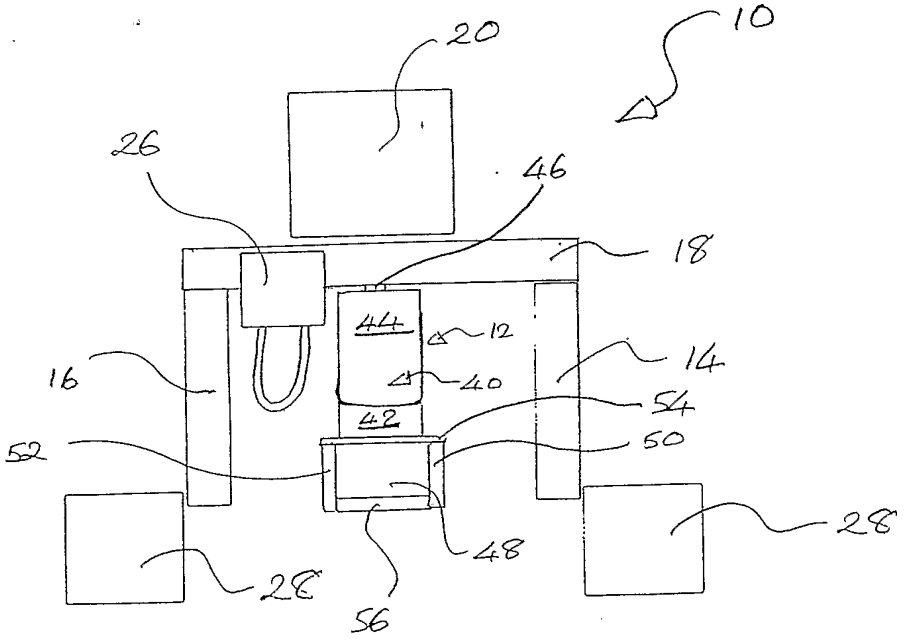

Figure 1b

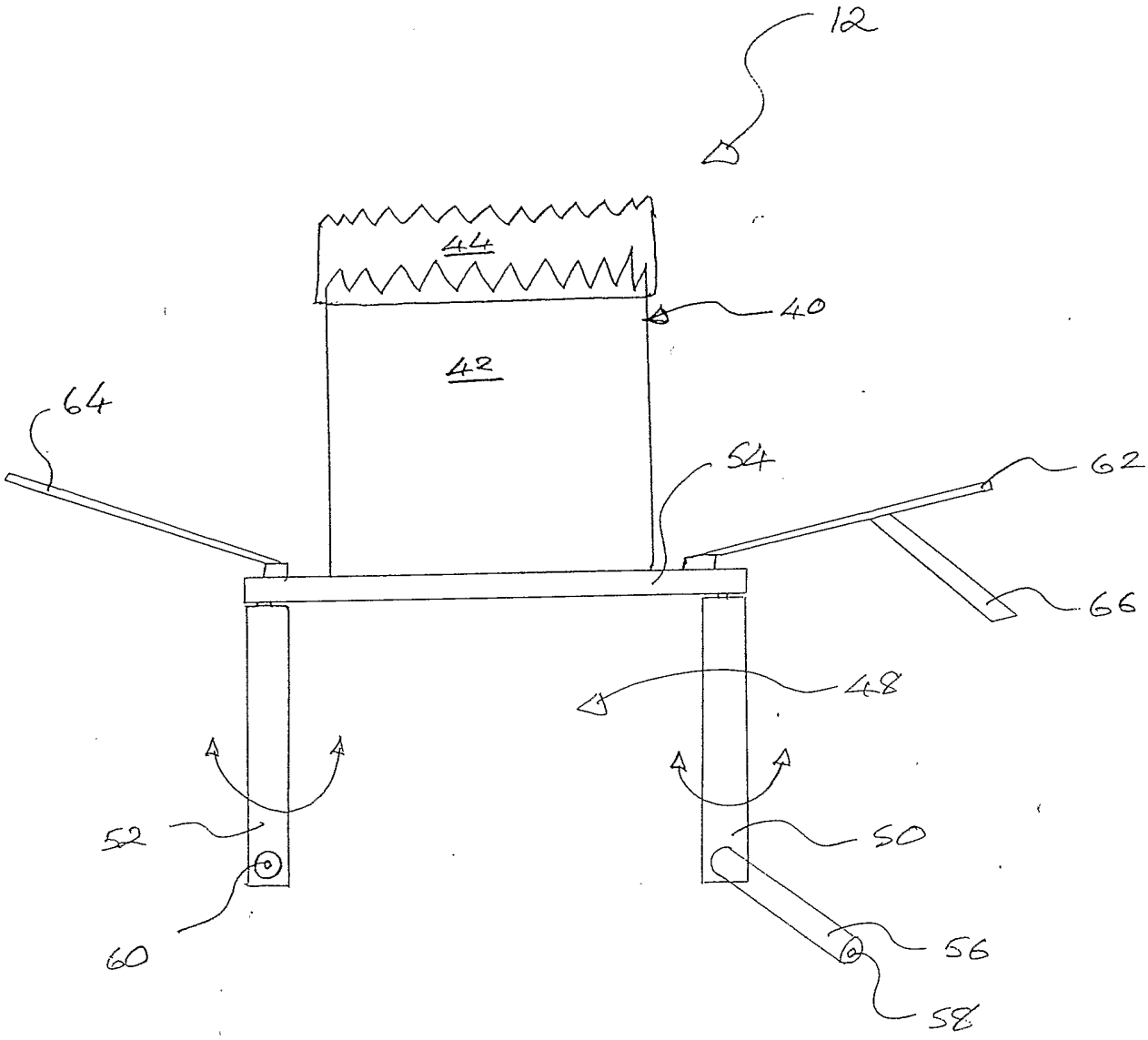

Figure 2

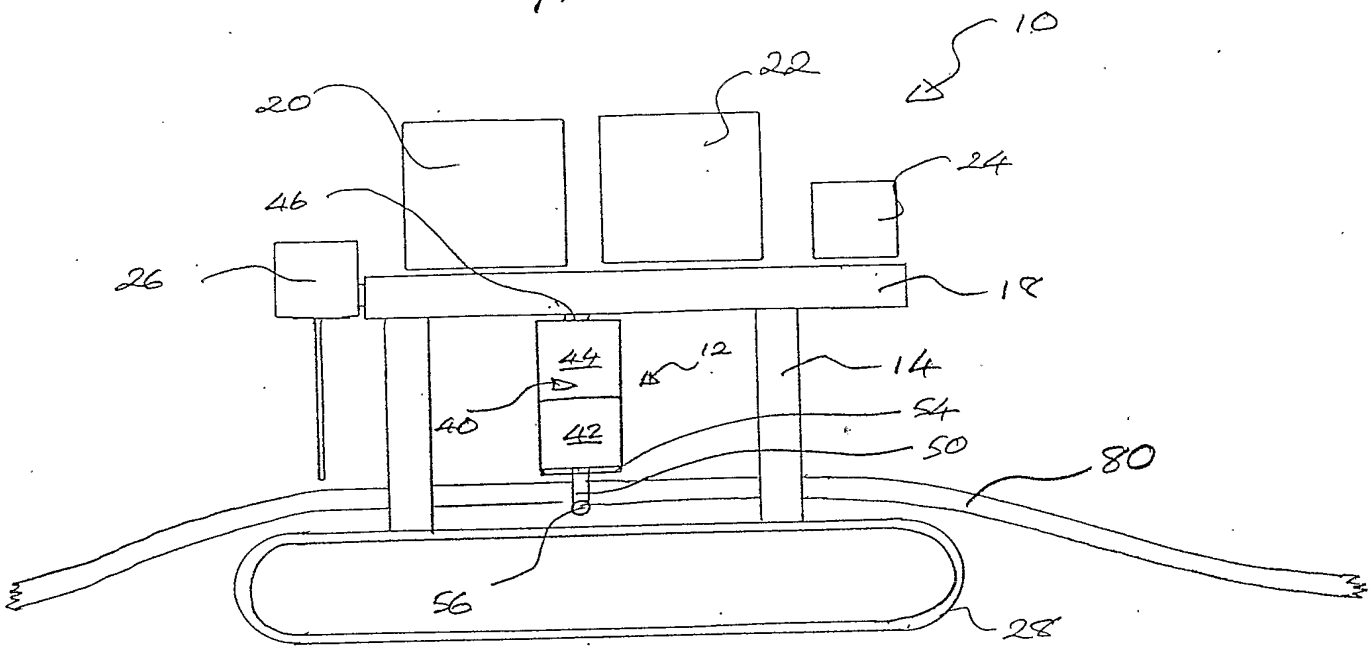

Figure 3a

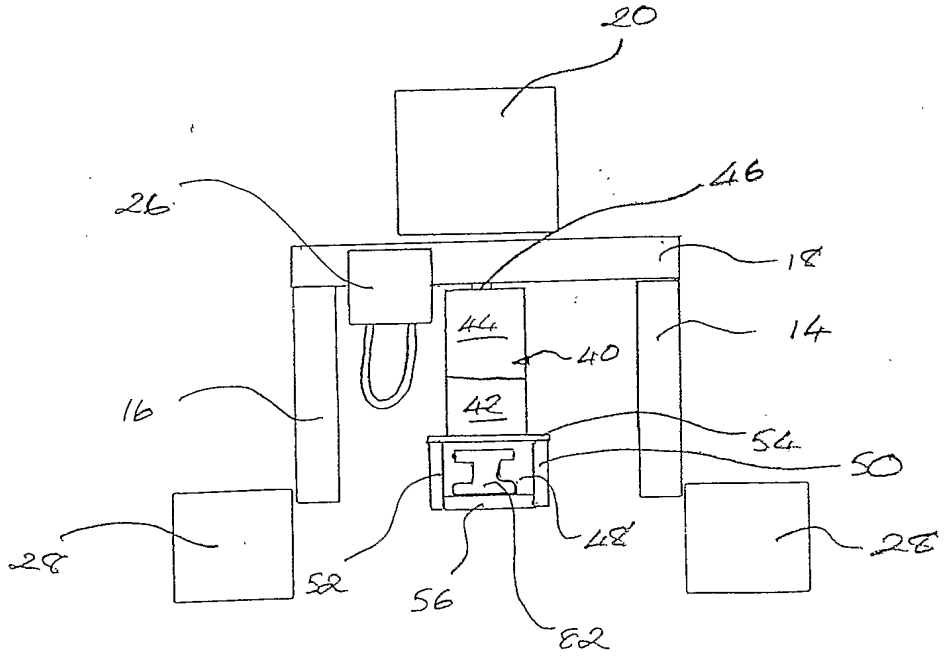

Figure 3b

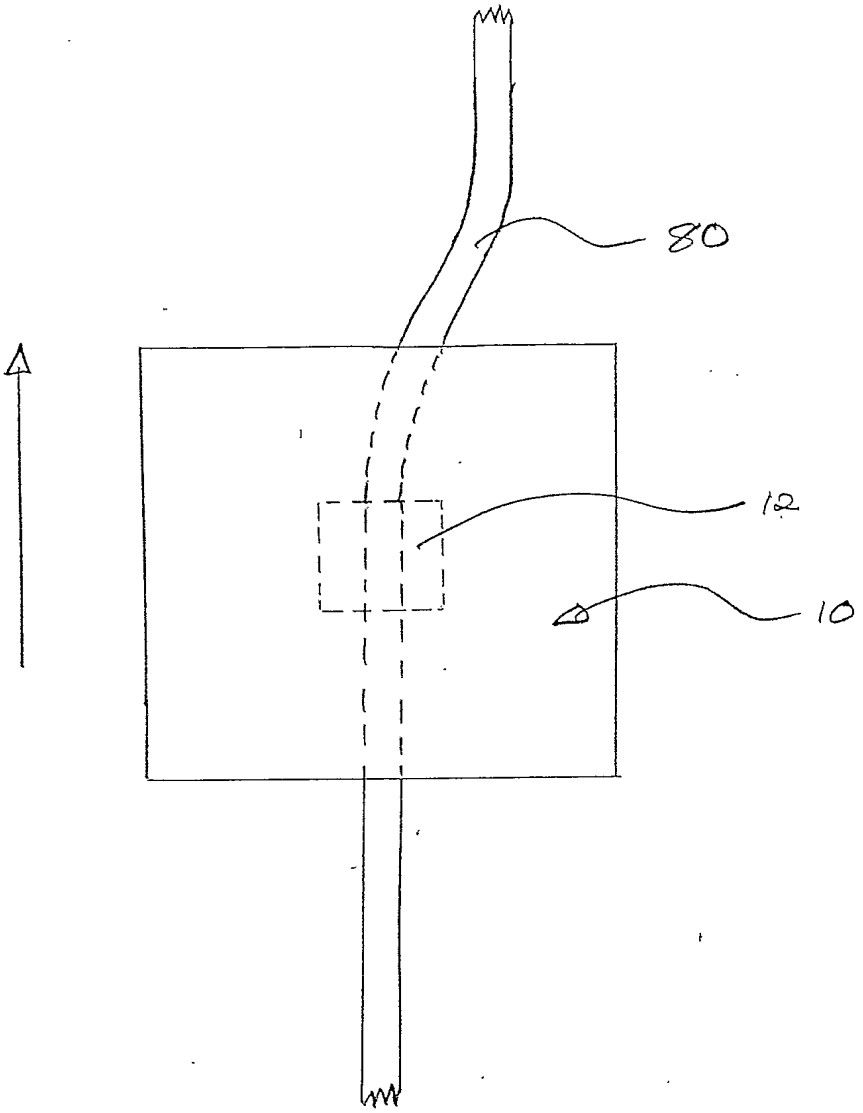

Figure 4